TO STUDY THE BIOLOGICAL INDICATOR OF WATER POLLUTION: A CASE STUDY OF SURFACE WATER RESOURCES OF KOLHAPUR CITY

A

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INTRODUCTION:

Water is one of the most vital components of the environment. It is a clear and known fact that clean water is entirely vital for healthy living [1]. Water is distributed in nature in different forms such as rain water, surface water, groundwater etc. Kolhapur city is a prominent city of South Western Maharashtra, is swiftly developing as a leading industrial and commercial centre. Owing to continues growth of human population, industrialization, use of pesticide in agriculture and many man-made activities, the natural aquatic resources are causing heavy and diverse pollution [2]. Thus, the development of city created directly or indirectly a number of water quality problems.

The Kolhapur city once supposed to have 40 small and large lakes is presently left with only few [1b]. The Panchganga River (PR) is one of the most important and major surface water resource of the city. Most of biodiversity develops near to the river but the rapid enhancement of pollution effects on the major natural resource. i.e., PR near to Kolhapur city. Hence, the water quality of river is continuity decline in past years. The declining of water quality is directly impact on the biodiversity.

Quality of surface water is denoted by its limnological study i.e., physical, chemical and biological features of natural resources. The Physico-chemical study could help in understanding the structure and function of particular water body in relation to its habitants. The proper balance of physical, chemical and biological properties of water in river, ponds, lakes and reservoirs is essential for limnological study [3]. It plays important role in plankton's and zooplanktons distribution and river stratification. The physical and chemical limnology of river is characterized by hydrological impact, autogenic nutrient dynamics and biological aspects. These factors combine with each other to determine the water quality and consequently [4].

Panchganga River (PR)

Kolhapur city is located near the Panchganga River (PR) and is surrounded by Sahyadri mountain ranges. It is a city known for its historical forts, temples, and royal places of former royals. It is one of the best places to explore the biodiversity due to its location. PR is one of the major backbones of natural water resources. Much more biodiversity is situated near to PR. The PR system is situated on the eastern side of the Sahyadri ranges. The streams originate at altitudes of about 800m to 900m. Beyond the union at Prayag, the PR flows over a broad plain at an altitude of roughly 550m [5].

The Bhogavati and Tulsi rivers, two of the five contributing streams, have dams constructed across them near their sources. PR system is formed by the junction of five northeast-flowing streams: Bhogavati, Tulsi, Kasari, Kumbi, and Dhamani. These streams meet the eastward-flowing Kasari River at a point called Prayag, which is situated around 12 km north of Kolhapur city and merged with the Krishna River at Narsihawadi near Kurundwad [5].

The PR system features wide muddy floodplains. After flowing about 60 to 80 km north, the Dhamani and Kumbi rivers meet at Chaugulewadi. The combined stream later meets the Bhogavati River at Bahereswar. The Kasari river originates near the village of Gajapur and flows southeast for around 25 km, followed by an eastward stretch of 75 km. The Kasari river is met by the Bhogavati River at Prayag. The lower reaches of the river beyond Bhogaon exhibit meandering patterns. Geologically, the Panchaganga river system has cut through layers of Deccan basalts, representing the Kolhapur unit of the Panhala and Mahabaleshwar Formation. Overall, this system showcases the complex drainage patterns and geological features that are typical of many river systems in the Indian subcontinent [5].

It is a major sub-tributary of the Krishna River. The PR plays a significant role in the biodiversity of the Kolhapur region. It is one of the natural reservoirs of Kolhapur city which is used to study physio-chemical and biological features, microbiological pollution, and study on plankton, and zooplankton.

STATEMENT OF THE PROBLEM

In the Kolhapur much more biodiversity dependent upon the PR. According to Maharashtra Pollution Control Board Report (MPCB) 90MLD municipal west [6] water mixed in the river through various channals like Jaynti and Dudhali nallahs. Owing to enhancing the water pollution day by day creates a crucial problem on biodiversity of Kolhapur region. Therefore, it is necessary to study in detail to check the water quality of Panchganga river water and understand the impact on biodiversity of Kolhapur.

To overcome this problem, we wish to study the surface water quality of natural resources of Kolhapur city. The present study attempts at assessing the physiochemical and biological parameter of PR and the effect of water on phytoplankton and Zooplankton

LITERATURE REVIEW:

Thorvat A.R, *et.al*, [7] discussed the water Quality Index of PR in Kolhapur city and water quality assessment is carried out from 2009 to 2010 on weekly basis in order to assess the environmental impact of disposal of domestic, industrial, household and agricultural waste into the river. Then Water Quality Index (WQI) study is carried out to assess the environmental impact on the water quality of the PR and to arrive at the level of pollution. For said study chosen 4 different location and found to be excessively polluted and are totally unfit for drinking purpose. This is mainly due to regular addition of domestic sewage, agricultural runoff, industrial wastes and other wastes that are let into the river through drains, nallahs in each station and it may lead to excessive pollution.

Mujumdar M. M. *et.al.* [8] In the present work on PR and the regression model. This regression model can be used to provide a mean for easier and faster monitoring of water quality in a PR. The correlation study and correlation coefficient values can help in selecting the treatments to minimize contaminants in river water.

Mulani S K *et.al.* [9] and coworkers deal with zooplanktons together with water quality of PR, in Kolhapur city, Maharashtra. The PR is a highly contaminated downstream with untreated sewage and industrial effluents, while flowing through Kolhapur city. The high value of CO_2, BOD, COD, phosphate, nitrate, Zn, Fe, Cu and low value of DO at discharge zone indicates increase in organic pollution The discharge zone is dominated by pollution tolerant zooplankton species such as *Brachionus, rotifera, Brachionus keratella, Filinia, Anuraeopsis etc*

D. B. Desai *et.al.* [10] studied the river water is generally polluted due to urbanization, ndustrialization and many more activities. PR is one of the most polluted rivers in Maharashtra (India) which originates at Prayag Sangam at Kolhapur and flows through border of Kolhapur. There are two big cities on the bank of river *viz* Kolhapur and Ichalkaranji Municipal Corporations. There are number of sugar industries, textile industries, sizing industries & many more types on the bank of this river. These all are responsible for pollution and therefore this river is now source of various waterborne diseases and being hazardous with increasing pollution. The attempt is made to analyze and discuss the causes, effects and corrective measures which can be exercised to control the pollution of PR. It will then minimize the sources of many problems and can provide healthy environment for all people, animal and aquatic life.

OBJECTIVE:

The present study has been taken up to highlight the decline of the surface water quality of Kolhapur city, because of the urbanization and industrialisation impacts on the water bodies. The surface water give abode to numerous biodiverse life forms. As biodiversity is intimately linked with the water, its pollution will affect the environment and ecosystem in the region. The current investigation objects to give a vision into this existing serious situation of the natural water resources revealing the consequence induced by the water on biodiversity. The following main objectives are:

- To monitoring the physio-chemical parameter of surface water throughout various seasons and explore the factors responsible for the pollution of water bodies
- To study the pollutant load of natural surface water resources.
- To confirm the source of pollution in natural surface water resources.
- To study the biological parameter and its effect on zooplankton and phytoplankton.
- Corelation between the biological indicator's species and other parameters.
- Spatial analysis of polluting area of Panchganga river and other surface water bodies by using and GIS mapping.
- To suggest remedial measures on the pollution of surface water bodies and future strategies.

In order to accomplish these objectives, road maps were prepared. Sampling spots were established, water samples were collected periodically and these samples were analysed by standard techniques.

STUDY AREA:

Kolhapur City (16° 42' N; 74° 14' E, height: 570 m), stands on growing ground on the south bank of the PR. At the origin of PR named as Bhogawati but at Prayag chikhali sub tributaries nameds as Kumbhi, Kasari, Tulshi, Dhamani confluence with bhogawati and form a PR. The river flows towards south-north side and meets river Krishna at Narsinhwadi, Tal: Shirol, Dist: Kolhapur. Sampling of water from PR at selected four location is being done on a monthly basis. Manual method of sample collection is favoured seeing all site conditions (Table1).

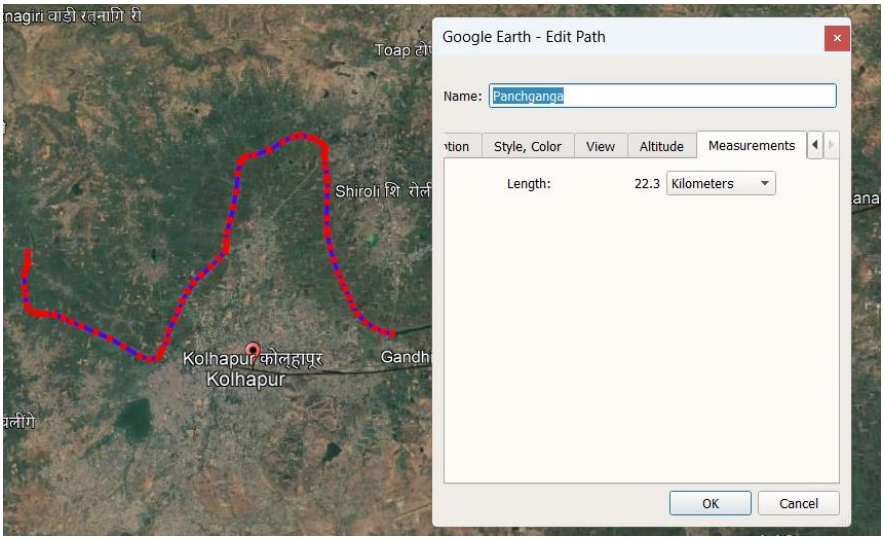

Fig1: Panchganga river around Kolhapur city

Table 1: GPS sites of Sampling spot

Sr.No	Sampling Site	Latitudes	Longitudes
Site 1	Jayanti Nala	16º42'33"N	74º13'09" E
Site 2	Dudhali Nala	16º42'15"N	74º12'52" E
Site 3	Bapat Camp	16º42'45"N	74º16'38"E
Site 4	Line Bazar	16º44'99"N	74º14'38"E

MATERIALS AND METHODS:

Sampling was done on monthly basis including pre and post monsoon respectively. Some essential Physico-chemical parameters like pH, Electrical Conductivity, Water Holding Capacity, Dissolve oxygen, COD, BOD, Minerals e.g., Calcium, Magnesium etc, Organic Carbon, Organic matter, Total Nitrogen, available Phosphorus and Potassium etc were analysed. All parameters were analyzed by standard environmental methods [11-13].

Zooplankton and phytoplankton were collected by using different mesh size plankton net from 50 litters of filtered water and concentrated up to 100 ml and preserved in 4% formalin. Literature was used for identification of zooplankton Adoni *et al.* [14], Tonapi [15], Edmondson [16].

Phytoplankton

Phytoplankton are microscopic, photosynthetic organisms that drift in aquatic environments, primarily in freshwater bodies. These tiny plant-like organisms form the base of the marine and freshwater food chains, serving as primary producers by converting sunlight and nutrients into organic matter through the process of photosynthesis. Phytoplankton are essential for the health and productivity of aquatic ecosystems and have a significant impact on Earth's climate and oxygen levels. It plays an essential role in various function. Photosynthesis, it absorbs CO_2 from atmosphere and helps to regulate the climate changes therefore, they are considered a critical component of the climate regulation system. it is also acting as primary food source for various freshwater organisms. passing energy and nutrients up the food chain.

Monitoring phytoplankton populations and understanding their distribution and behaviour is vital for evaluating the health of aquatic ecosystems, tracking changes in the natural resources of freshwater bodies, and studying climate-related processes. Phytoplankton is different in their size, biomass and distribution and collection of their sample's posses' practical difficulties Due to nutrient high presence or less may diversity possess in phytoplankton biomass. Thus, the phytoplankton volume of sample to be filtered through the fixed mesh size net is helpful to the phytoplankton collection. The Plankton samples will be collected using a plankton net then transfer sample through funnel in to polythene bottle. Collected sample of phytoplankton preserved by adding 5to 10 ml of Lugol's iodine. Normally sedimentation requires 24hrs. After which the sediment is collected after removing supernatant with the help of dropper or pipette. If the sample content with sedimented phytoplankton is diluted by adding the distilled water can once again preserved in Lugol's iodine for subsequent studies. Then to identifying the phytoplankton species will be use common glass slide mounted with a drop of concentrated phytoplankton sample by adding glycerol and covered with cover slip will be placing under the microscope provided with mechanical stage to phytoplankton species identification

Zooplankton

Zooplankton are playing a crucial role in biodiversity and an essential food source for many aquatic organisms, including small fish, and filter-feeding organisms. Additionally, changes in zooplankton populations can denote shifts in ecosystem health and environmental conditions. Scientists study zooplankton populations to better

understand the dynamics of aquatic ecosystems, monitor changes in species composition, and assess the impacts of environmental factors such as temperature, nutrient availability, and pollution. Zooplankton research provides valuable insights into the overall health and functioning of aquatic environments. Sampling of zooplanktons is same as phytoplankton.

WORK PLAN:

Sr.No	Time (Month)	Work
1	00-06	Review of Literature and Procedure Preparation
2	06-30	Analysis of Water Sample and physiochemical biological study. publishing research papers
3	30-36	Data Collection/Statistical Interpretation, Writing of Thesis

EXPECTED OUT COMES:

- ✓ Determined physio-chemical parameters of surface water which helps to comments on the qualitative and quantitative pollution of water. In future, it helps to minimized the pollution of water bodies.
- ✓ To get actual data microbiological contamination and biological features of bacteria in Panchganga river.
- ✓ To get the most polluted site of Panchganga river and other surface water bodies with the help of GIS mapping. It helps for to take corrective mergers and exact planning of industrial and urban area.
- ✓ To get major information of effect of pollution on Phytoplankton and Zooplankton.
- ✓ Exploring the Water Quality Index of Panchganga river and study well the effect on biodiversity of Kolhapur city.

REFERENCE:

1] a) Mangalekar S. B, Samant J.S. Evaluation of Water Quality of Panchganga River with reference to Waterborne Diseases. *Inte. J. of Sci. Res.,* 4 (10), **2015**, 417-420. **b)** Trivedy R.K., Garud J.M. Goel P.K., Studies on chemistry and phytoplankton of few freshwater bodies in Kolhapur with special reference to human activity, *Journal of Poll. Res.,* 4(1), **1985,** 25-44.

2] Shete R, Kommu R, Panchganga River Pollution: A Case Study. *Inte. Res. J. of Mod. in Engg, Tech. & Sci.,* 4 (4), **2022**, 1707-1725.

3] Patil S G, Chonde S. G, Jadhav A. S, Raut P. D. Impact of Physico-Chemical Characteristics of Shivaji University lakes on Phytoplankton Communities, Kolhapur, India. *Res. J. of Rec. Sci.* 1(2), **2012**, 56-60.

4] Kolhapur Municipal Corporation (KMC), A Report on City Development Plan for Kolhapur City,**2008**.

5] Kulkarni A, Powar K. B, Quality of Surface and Ground Water in Panchaganga River Dasin, Kolhapur District, Maharashtra. Ph.D Thesis, **1993**.

6] Maharashtra Pollution Control Board (MPCB), Environmental Status Report for Kolhapur City,**2005-06**.

7] Thorvat A.R, Sonaje N.P, Mujumdar M.M, Swami V.A, A Study on the Physico-Chemical Characteristics of Panchaganga River in Kolhapur City, MS, INDIA. *Res. J. of Chem. Sci*. 2(8), **2012**, 76-79.

8] Mujumdar M. M, Thorvat, A. R, Sonaje, N. P, Development of Regression Model for The Panchaganga River Water Quality in Kolhapur city, M.S. *Int. J. of Engg. Res. & App*. 1(4), **2011**,1723-1730.

9] Mulani S. K, Mule M.B. Patil S.U, Studies on Water Quality and Zooplankton Community of the Panchganga River in Kolhapur City, *J. of Envt. Bio.,* 30(3), **2009,**455-459.

10] Desai D.B, Devkar P.S, River Pollution: A Case Study of Panchaganga River. *Inte. Res. J. of Mod. in Engg, Tech. & Sci.,* 7 (3), **2020**, 30-32.

11] APHA standard methods for the examination of water & waste water port city press, Baltimore, Maryland, USA**, 2001**.

12] Maithi S. K. Handbook of methods in environmental studies vol.1: water and waste water analysis, second edition- **2004**, published by ABD publisher, Jaipur – 302015.

13] Khare S.L, Pau l S.R, Dubey A, Nature environment and pollution technology, 6 (3), **2007**.539-540.

14] Adoni A.D, Joshi D.G, Chourasia S.K., Vaishya A.K., Yadav M, Verma H.G, A Workbook on Limnology Published by Department of Botany, Dr. Harisingh Gaur Vishwavidyalaya Sagar, India.**1985**.

15] Tonapi, G. T.; Fresh water animal of India. Oxford and IBH Publ. Co. New Delhi **1980**. 311.

16] Edmondson W.T, Fresh Water Biology. 2nd Edn., John Wiley and Sons. INC, New York. **1963.**

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